[ROYCE (Wm A.)]

Disinfection of Vessels & Hospitals

BY THE USE OF

COMPRESSED AIR.

Bind Cover in front

LETTER OF DR. ROYCE, THE INVENTOR, TO THE

SECRETARY OF THE NAVY.

METHOD OF ABATING YELLOW FEVER,

&c. &c.

OFFICE OF HORACE H. DAY, OWNER OF THE PATENT PRIVILEGE,

61 LIBERTY STREET,

AND AT THE

Delamater Iron Works, 13th Street and North River.

PRICES FOR EACH SHIP $5,000 TO $10,000, ACCORDING TO THE SIZE OF THE VESSEL, TO INCLUDE PATENT AND APPARATUS.

1873.

C. Shepherd, Steam Job Printer, 225 William St., N. Y.

ON THE

SUPPRESSION of YELLOW FEVER

On SHIPBOARD and in HARBORS.

Office of the COMPRESSED AIR POWER CO.,

AT THE DELAMATER IRON WORKS,

10th & 11th Aves., and 12th, 13th & 14th Sts. North River.

And 61 Liberty Street, New York.

Copy of Letter to the Secretary of the Navy.

March, 1873.

To the Hon. The SECRETARY of the NAVY :

The undersigned is patentee of an invention of machinery which is designed, for one of its objects, TO REDUCE THE TEMPERATURE OF THE AIR and of inanimate objects in such enclosures and premises as cabins, steerages, forecastles, wards in hospitals, public and private rooms, &c., in any warm climate, or weather, as low down as desirable, even to zero of Fahrenheit during any reasonable, and essential length of time.

The disinfectant power of frost can be readily applied to all parts of a large ship, in successive large fractional parts, and retained sufficiently long to perfectly destroy the germs of yellow, typhus and typhoid fevers within the enclosures.

The hygienic and therapeutic influence of any suitable mild, or cool atmosphere, can be secured in all the necessary enclosed apartments on shipboard, and in hospitals, nurseries, hotels, etc.

The convenient agency to bring about a result in accordance with the above assertions, is compressed air ; which having been condensed and cooled, is either worked expansively or not, and delivered through a hose or conduit, at such temperature and in such volume, as is commensurate with the space, or room, the heat to be overcome, and the object sought.

The only obstacles which have hitherto prevented the application of compressed air to the above and many other uses, have been completely surmounted by this invention.

An inspection of enclosed rather rude drawings, and accompanying specifications, will give an idea of the apparatus for the condensation of the air for this service.

The size of the machinery and the density of the air treated, is entirely optional—provided that the power to operate it is sufficient for the resistance—the supply of cooling water at ordinary temperature is adequate to absorb the heat evolved, (which is a very small fraction of water compared with the volume of air,) and the compressors, reservoirs, and auxiliary exhausting engine, are of corresponding and appropriate strength.

The *potency* of frost to disinfect the fomites of yellow fever, is no longer a matter of doubt by any considerable proportion of the medical profession : but the *feasibility* to invoke and command the aid of cold air, in hot weather, in such measure as to effectually serve so desirable a purpose, is quite foreign to the line of study, thought, and investigation, which naturally and properly engross the mental energies of that profession : hence a similar suggestion to the foregoing, which was read to the last

National Sanitary Convention that met in New York City previous to the late Civil War was not received with the slightest appreciation by any one of the large body of medical savans constituting that Convention, with the exception of Dr. Griscom, of New York. Their Secretary, Prof. Chas. H. Haswell, previously of West Point, who read the document to them, was immediately impressed with its practicability, and volunteered some commendatory remarks, but as he was not a member and had no *parliamentary* privilege in such a case, the subject was dropped, and has remained dormant until the present time, when it is to be hoped that the advancement in science, and a more intelligent if not a broader philanthropy, will lead the Honorable Secretary of the Navy to give to the world a demonstration of the power of compressed air, in obviating the ravages of the most fatal of infections, and in mitigating immense suffering on ship board.

Aided by data, accumulated through the exertions of a body of late scientific experimenters and observers, together with familiarity with past records, the brilliant Mathematician, Prof. Rankine, (whose recent demise has cast a gloom over all the votaries of physical science,) has produced a "Manual of the Steam Engine, and other Prime Motors," which on consultation will shed a broad light on the capacity of compressed air to afford intense frigidity when expanded—the force required to compress it—also the aid which can be had from the Auxiliary Engine, after the reservoir is filled up to the required density, at which it is to be kept charged, until the completion of the disinfecting process.

For convenience, the following table will exhibit some of the facts tending to attract attention to the subject proposed. The heat is measured by Fahrenheit's scale, and

the air taken into the compressors at such high range as is conducive to the development of the pestilence desired to be subdued.

The frigidity is found by Rankine's formula, and the resulting volume by Gay-Lussac's law.

Ratio of Compression in Atmospheres.	Final Temperature from Air taken in at 80°	Final Temperature from Air taken in at 120°	Volume when cooled and discharged.
2 into 1	Below Zero, 18°	Above Zero, 14°	,82
3 " 1	" 68°	Below Zero, 38°	,73
5 " 1	" 122°	" 97°	,63
8 " 1	" 165°	" 143°	,55
10 " 1	" 184°	" 163°	,51
15 " 1	" 214°	" 196°	,46
20 " 1	" 234°	" 217°	,42

The drawings make no exhibition of the power that is to work the condensers, as the original patent is old, and includes the use of *any* known competent power, but being re-issued lately, and divided into sections, this special use for the Marine Service, would necessarily imply that the reciprocal steam engine should be the prime motor, and its crank attached to the crank shaft, and at an angle about from sixty to ninety degrees from the radial line, or plane of the crank or cranks of the compressing cylinders, so as to apply maximum power of steam engine, to maximum resistance of compressors.

The Auxiliary Air Engine alluded to—which is requisite to *work off* the elastic force of the air, after being compressed, cooled, and stored in the reservoir until sufficient density is attained—is to be either attached to the crank

shaft in a similar manner as the steam engine, and the air from the reservoir made to surrender all its force in economic aid of prime motor; or it can be worked independently at any other desirable service on ship-board, caution being observed to permit no considerable increment of heat after the departure from the reservoir, until the delivery of the expanded air into the apartment to be disinfected by frost.

It is readily apparent, that both the Prime (steam) and Auxiliary (air) Engine, will require the best adjustable "cut-off," to operate at best advantage.

It is scarcely presumable that for the disinfectant use, any density exceeding ten atmospheres (150 lbs. per square inch.) will ever be required; and quite likely that five to eight atmospheres will be sufficient to afford all the frigidity that will be demanded in any climate, the volume being duly proportioned to the space.

Numerous practical experiments with a single cylinder condenser, and the hollow piston and rod, combined with a circulating jacket of ordinary summer heated water, have determined the fact that summer heated air can be kept down in temperature near the initial heat, when condensed to 150 lbs. per square inch; but the abrupt falling off from maximum (150 lbs.) to minimum (0 lbs.) resistance per inch. at each stroke of compressor at maximum power of engine that drives it, necessitates a much heavier machine in all its parts than is needed to perform the same amount of compression by the "serial process,"—which convenient process dispenses with the hollow piston, and rod, allows cooling to be accomplished by the worm and immersion only, and with much less worm than exhibited in the drawing when moderate density is added at each stroke.

The *spray cooling injection* would probably dampen the air too much for the disinfecting service in *ships*, although quite satisfactory at Hoosac Tunnel, Mass., where it controls the temperature, evolved by 50 to 60 lbs.compression

per square inch. The details of the process of disinfecting a ship with this frigid element, will doubtless require some practice to ensure the greatest perfection of application, with the least expenditure of physical force, and time; but it is deemed not very unsafe to *premise* that the proportions of a given vessel which can be conveniently and alternately separated from the rest for the time required to disinfect being ascertained ; the cubic yards contained within that fraction of her being found, and, *assuming* that the air within that enclosure will need to be entirely renewed every hour from begining until disinfection is completed, at a temperature corresponding to the rarefaction due to a density of eight (8) atmospheres,and that the absorption of heat by the air, would be too slow to justify waiting for the expansion of the initial volume, beyond seven-eights ($\frac{7}{8}$) of its condensation (or two atmospheres in one, with temperature much below zero) and the condenser that will compress eight (8) times that number of cubic yards of the warm air per hour, will furnish the proportion of eighty-two (82) per cent., and increased eighteen (18) per cent. is about the capacity required for the vessel,with strong probability of being in excess of the required volume to do the work.

It is proposed to divide the vessel into suitable apartments, by tacking air-tight canvas athwart-ship from deck timbers above to floor below, either one or two thicknesses, as may be found necessary to prevent the waste of frigidity by mixture or conduction. In some cases the need to stretch curtains lengthwise, will doubtless be manifested. This canvas may be coated with rubber or any convenient sizing, simply, or mixed with a disinfectant.

To ward off the sun's rays by stretching canvas over the bulwarks and dipping the ends of it down into the water, on one or both sides of the part under treatment, will aid materially the process ; also, sprinkling the deck, before and during the operation, with water, simply, or containing disinfectants, will promote success and dispatch.

After the curtains have been properly secured in place, all the baggage, bedding, clothing, linen, books, packages, stores, provisions, furniture, etc., etc., which are to remain in the apartments, should be either suspended or spread out in the thinnest and most exposed manner, to afford the access of cold air to all parts of each article, and to the state rooms, berths, closets, trunks, etc., etc.

The flow of the cold air from conduit, or hose, should escape through a long cylindric or elliptic basket, constructed of steel wire, (like skirt hoops,) provided with a sleeve coupling at each end, to unite with the hose, and with each other, and also a throttle valve, (like a stove-pipe damper,) at one end, so as to control the flow out of the basket—which basket being covered with one or two thicknesses of coarse, sleazy hair or fibre fabric, will diffuse the cold air in every direction, and prevent a wasteful agitation and mixing of the cold air with the warm by the jet, which otherwise would follow the influx.

Thus restricted through one or more conjoined baskets, supported a few inches above the floor, the flow would necessarily gravitate and steadily lift upward and displace the warmest air within the enclosure, ejecting it through the companion, hatch, or other uppermost opening provided for its escape.

Persisting until the escaping air shall indicate that all below must have sunk in temperature a few degrees below the frost point, will ensure the disinfection of that apartment, which should then be immediately closed at all points.

Proceeding to the adjacent apartment immediately after finishing the first, and before the warming of the air in the first by conduction, and while the expanding air in the first enclosure will resist the possible influx of the noxious germs in the second apartment, which might otherwise be

transmitted through fissures, in or around the curtain, and thus throughout the vessel.

The vessel after disinfection, should retain one small apartment, under the frost range, into which all the clothing of the occupants of her, which may have been there previous to her disinfection, should be placed, and subjected to proper disinfection—also, all stores, provisions, and supplies coming on board from infected or doubtful sources, should pass this prophylactic apartment before distribution.

When a *fleet* is to be stationed at, or exposed to, a malarious or infectious climate,even a small vessel provided with sufficiently capacious condenser, could disinfect the whole fleet by turns, also purify the supplies taken on board any vessel, (naval or national,) and if required, ameliorate the temperature on the hospital ship.

On such vessels as require the use of steam to charge and work heavy guns, the service of air can be substituted with much greater safety, and equal or greater efficiency, thus securing the double advantage of preserving friends, and destroying foes.

On sailing vessels, the service of a small compact boiler located as near the keel as prudence demands, so constructed as to require no draft after steam is developed sufficient to start work, and but small apertures for ejecting gases, which may be placed at any convenient part of the hull, with engines peculiarly adapted for the work of compressing air and with proper reservoirs, would render the same service in the emergency of a short engagement, that a steamer would afford, also all the disinfectant and therapeutic aid for *any* length of time.

The foregoing description it is hoped will quite suffice to present the general features, and ensure its ultimate successful adoption.

Appended is the endorsement of the general idea by the *ripe savan* Prof. Henry.

Yours most respectfully,

WM. A. ROYCE, M. D.

Newburgh, N. Y.

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" SMITHSONIAN INSTITUTE, Washington,

December 17th, 1872.

Mr. ROYCE, of Newburgh, N. Y., has submitted to me his plan for cooling the holds of Ships, by means of the condensation and subsequent rarefaction of air.

The cooling of a large volume of air in the manner he proposes, is entirely practicable, an adequate amount of power being expended in doing the work.

I have given no attention to the details of his machinery necessary to produce the work, but this is a matter of ordinary engineering.

JOSEPH HENRY, Sec'y, S. I."

The following suggestions in respect to the use of this Invention in Harbors, to abate the ravages of Infectious Fevers and for Extinguishing Fires, may be deemed worthy of general consideration; and might be appropriately brought to the special consideration of the Port Wardens, Boards of Health, the Chamber of Commerce and other public Bodies.

Whereas a common tug-boat might be fitted up to answer a good purpose, same time making demonstration—thus to remove all doubt of the success of the principle, ultimately small vessels would be constructed and adapted in all respects to this service. A proper plan would be a vessel made entirely of Iron or Steel or otherwise a fire-proof craft. She would carry one or more Air compressors. The hull of this vessel so constructed either tubular or otherwise as to form in itself a reservoir for a large supply of accumulated power, rendering it unnecessary to fire up her boilers, except in cases of protracted use. The vessel should be constructed for speed and rapid handling, and carry only the most condensed fuel.

The same machinery and appliances used to compress and transmit the air for refrigeration, could be made with slight variation equally useful for throwing water: the different compartments may be adapted to hold power (the compressed air) in store of different degrees of density or pressure.

In all this nothing new remains to be invented, yet recent discoveries and improvements give promise of greater *economy* and eminent success in the use of cheaply constructed, compact engines of light weight, yet of great strength and power.

A craft of the above description, whose station might be at the Battery, or in the vicinity of Governor's Island, made accessible to telegraphic communication throughout the cities of New York, Jersey City and Brooklyn, could be sent in a few minutes to any part of the Harbor—her stored power always serving for instant use in propulsion. The saving of life and property, from this instant service in fires, explosions, collisions, etc., might return many times the outlay in a single month, independent of the main purpose of staying pestilence.

She could thrust herself among burning ships, where fire-proof cables could be attached to tow them out. throw water in many streams like a cataract, and thus we have a vessel practically capable of suppressing both disease and fire.

It will be remembered that the Steam Fire Engine, has but just emerged above the popular doubt and sneers at the "visionary inventor," despite the inventors poverty, mortification and exhausted mental and physical energies.

Like the Ocean Steamers, the Telegraph, the Railroad Locomotive, it has established its place in human progress; and to-day on its saving and securing force, repose in quiet confidence, untold millions of invested wealth, and even life itself.

It is confidently expected this invention, which in other departments, and applications, has already established its controling power, will in this line of its humane and beneficent use, fulfill one of its highest missions. Its application in this department will be attended with comparatively trifling outlay.

W. A. R.